

# Season Extension and Winter Growing

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**Massachusetts Urban Farming Conference**  
**Boston**

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**ATTRA**  
SUSTAINABLE AGRICULTURE

A PROGRAM OF THE NATIONAL CENTER FOR APPROPRIATE TECHNOLOGY



NATIONAL CENTER FOR  
APPROPRIATE TECHNOLOGY

**Helping People by championing small-scale,  
local, and sustainable solutions to reduce  
poverty, promote healthy communities, and  
protect natural resources.**

<http://www.ncat.org>



**ATTRA** provides technical support on sustainable agriculture and farm energy.

- <http://www.attra.org>
- Toll Free 800-346-9140
- > 400 Publications
- Workshops/Conferences

**What Is Sustainable Agriculture?**

Master Publication List

Education

Energy Alternatives

Beginning Farmer

Field Crops

Horticultural Crops

Livestock & Pasture

Local Food Systems

Marketing, Business & Risk Management

Organic Farming

Pest Management

Soils & Compost

Water Management

Other Resources

**"Armed To Farm" is Sustainable Agriculture Training For Military Veterans**

NCAT has partnered with the USDA Agricultural Research Service, Farmer Veteran Coalition, University of Arkansas, Growing Warriors, and other sustainable agriculture organizations to train veterans interested in sustainable agriculture careers.

[» Learn More](#)

**Helpful Links**

♦ Sustainable Ag Webinars	♦ Organic Livestock Feed Suppliers	♦ Sustainable Producer Spotlight
♦ Upcoming Workshops	♦ Disaster Assistance	♦ Ecological Pest Management
♦ Organic Seed Suppliers	♦ ATTRA Newsletters	♦ Cosecha Mensual
	♦ Drought Programs and Resources	(Spanish-language e-newsletter)

**Ask An Ag Expert**

Use this online form to submit sustainable agriculture related questions to our Specialists.

**Internship Opportunities**

Sustainable Farming Internships & Apprenticeships

A directory of on-the-job learning opportunities.

**News** **Calendar** **Funding**

- ♦ Israeli Research Shows Encouraging Birds of Prey Reduces Rodenticide Use ~ 01/20/15
- ♦ California Strawberry Growers Consider Methyl Bromide Alternatives ~ 01/20/15
- ♦ Federal Court Rules Manure Can Be Regulated as Solid Waste ~ 01/20/15
- ♦ Report Details Opportunities For Agricultural Businesses To Grow Northeast Regional Economies ~ 01/19/15
- ♦ More Breaking News...



# Lent's Organics



Photo: Chris Lent, NCAT



# Benefits of Season Extension

- Maintain markets for longer
- Better quality /fewer pests
- Higher prices (out of season produce)
- Increase cash flow
- Spread out your labor over more seasons
- Manage risk on your farm

# Zoning and Permits

- Boston Redevelopment Authority (BRA)
  - Article 89 (zoning code)
- Comprehensive Farm Review (CFR)
  - Residential
  - Small scale commercial
- Apply for permits (water, electrical, composting)
- **Building Permit**
- Use of Premises and Business Permits

Article 89 Made Easy:

Urban Agriculture Zoning For The City of Boston



# High Tunnel Zoning

## Ground Level Farms

- Height limits
  - Per zone
- Set back requirements
  - 5 feet

## Rooftop Farms

- 25 ft. height limit
- Setbacks determined by building/safety and fire codes

Urban Agriculture in Boston: Permits and Approvals  
Needed to Start Your Less Than One Acre Farm

# Key Elements of Season Extension

- **Site Selection**
- Crop selection
- Protect plants
- Timed plantings



*Photo: Chris Lent, NCAT*



# Lowest Hanging Fruit

- Take advantage of wind breaks
- Take advantage of higher ground
- Raised beds
- Plastic ground cover



# Plastic Ground Covers



Photo: Chris Lent, NCAT

- Warms the soil
- Increases winter growth
- Infrared transmitting (IRT) or black
- Cold season crops
  - Lettuce
  - Kale
  - spinach
- Agricultural plastic issues



# Site Selection

- Soil condition and fertility
- Accessibility (bed prep, watering, planting, harvest, soil amendment)
- Well drained soil



*Photo by Katherine Adam, NCAT*

# Water Drainage

One inch rainfall  
30 X 96 high tunnel  
3,552 sq. ft.  
2,000 gallons



*Photo Chris Lent, NCAT*





*Photo: Chris Lent, NCAT*

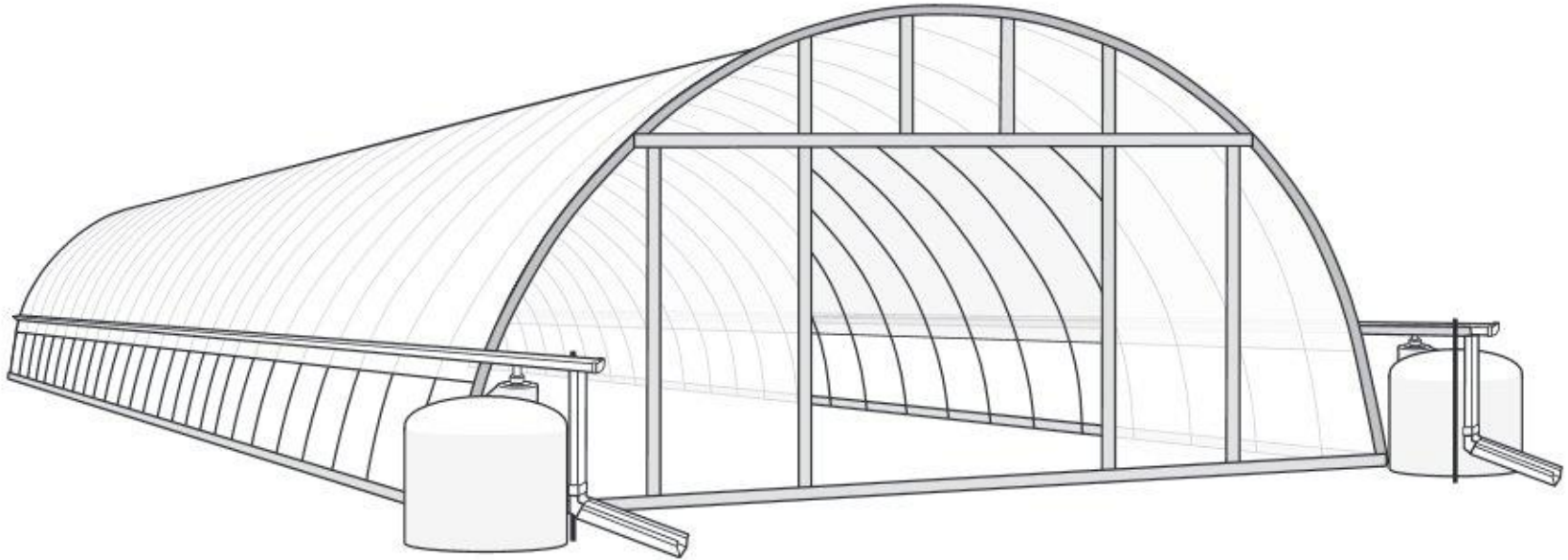




*Photo: Chris Lent, NCAT*



# Rainwater Catchment



*Iowa State Extension manual: Written by Shawn Shouse, Extension Agriculture Engineer, and Linda Naeve, Extension Program Specialist*

**Iowa State High Tunnel Rainwater**

[https://www.youtube.com/watch?v=XsxRZQR\\_7VU](https://www.youtube.com/watch?v=XsxRZQR_7VU)

# Compaction



*Photo: Andy Pressman, NCAT*



# Key Elements of Season Extension

- Site Selection
- **Crop selection**
- Protect plants
- Timed plantings



*Photo by Chris Lent, NCAT*

# Crop Selection

- Markets
- Cold hardiness
- Disease resistance
  - Downy Mildew
  - Lettuce Mosaic Virus

Seed Catalogs



*Photo: Chris Lent, NCAT*



# Possibilities

## Fall / Spring harvest:

- lettuce, endive, chicories
- Asian greens
- Spinach
- Kale
- Raab
- Beets and Chard
- Turnips
- Radish
- Carrots
- Leeks

## Winter harvest:

- Hardest greens
  - Mizuna
  - Corn Salad
  - Asian Greens
- Spinach
- Carrots
- Chard
- Scallions
- Kale
- Leeks

# Harden Off Plantings



*Photo: Chris Lent, NCAT*

- Expose to increasingly cold temperatures
- Leave vents and doors open until high-twenties

# Key Elements of Season Extension

- Site Selection
- Crop selection
- **Protect plants**
- Timed plantings



*Photo by Chris Lent, NCAT*

# Wire Hoops



*Photo courtesy of SPIN Farming*

- Low Cost (\$.15/sq.ft.)
- Fast
- Multi use
- Moveable
  
- Not for winter production
- Labor intensive



# Low Tunnel



*Photo: Chris Lent, NCAT*



# Winter Low Tunnel



*Photo: Chris Lent, NCAT*





\$.25/ sq. ft.

*Photo: Chris Lent, NCAT*

# Hoop House



*Photo courtesy of SPIN Farming*

- About \$.75 to \$1.00/sq. ft.
- Readily available materials
- Fast install
- Hard to use equipment
- Wind and snow damage





*Photo Chris Lent, NCAT*





*Photo: Chris Lent, NCAT*







# Caterpillar Tunnel





# Bend Your Own



\$2.00 – 2.50 per sq. ft.

Photo: Chris Lent, NCAT





# Construction



*Photos: Chris Lent, NCAT*







*Photos: Chris Lent, NCAT*



# High Tunnel



*Photo: Chris Lent, NCAT*

- Cost (\$2.50 to \$3.50/sq. ft.)
- Room for equipment
- Head space for trellising
- More efficient
- Higher cost
- Higher labor to install
  - 40 to 80 hours

# Quonset



*Photo Andy Pressman, NCAT*



# Gothic



*Photo: Chris Lent, NCAT*



# Moveable Tunnels



Photo: Chris Lent, NCAT

- Effectively doubles protected space
- Can work uncovered areas more easily
- Exposes soil to rain
- Can help with rotation and cover cropping
- Up to 1/3 more cost
- Susceptible to wind



# Movable



*Photos courtesy of Rimol Greenhouse Systems*





*Photo: Chris Lent, NCAT*





*Photo: Chris Lent, NCAT*



# Key Elements of Season Extension

- Site Selection
- Crop selection
- Protect plants
- **Timed plantings**



*Photo by Chris Lent, NCAT*

# 1. Cover field crops

- Brassicas, root crops, greens

# 2. Plant for winter harvest


- Last day with 10 hours of light

[timeanddate.com/sun](http://timeanddate.com/sun)

- 75% growth before that date (November 8<sup>th</sup> Boston)

# 3. Succession planting throughout fall and winter



Key 		Planting Dates for Winter Harvest Crops																	
CROP		Start Transplants	Direct Seed	Week 15	Week 14	Week 13	Week 12	Week 11	Week 10	Week 9	Week 8	Week 7	Week 6	Week 5	Week 4	Week 3	Week 2	Week 1	Last 10-Hour Day
TIER 1	Kale (Full)	•		15	14	13													
	Tatsoi (Full)	•								9	8								
	Spinach (Full)	•	•								8	7							
	Claytonia (Full)		•								8	7							
	Kale (Baby)		•									7	6						
	Spinach (Baby)		•										6	5					
	Tatsoi (Baby)		•										6	5					

Johnnyseeds.com

Spinach: 8 weeks - September 13<sup>th</sup>  
 7 weeks - September 20<sup>th</sup>

# Crop Planning Chart

Winter crops plan 2016					Actual Harvest Date	Ten lbs/week	Notes	
Crop	Planting	Row ft.	Bed ft. (5 rows)	Harvest Date				
Spinach	Sept. 13	120	24	Nov. 8-15		10	Tyee	
	Sept. 20	240	48	Nov. 22-29		20		
	Sept. 24	480	96	Dec. 6-13		40		
				Dec. 13-20		40	Second cuttings	
							Break for holidays	
				Jan. 3-24		20	Sept. 24 plantings	
	Jan. 19	240	48	March 7-14		20	Donkey	
	Feb. 1	240	48	March 21-28		20		
	Feb. 27	240	48	April		20		
Based on zone 5 hardiness and frost dates.								





*Photos: Pearl Wetherall, New Morning Farm*



# Sample Enterprise Budget: High Tunnel Production

Fixed Costs					
Item				Year 1	Years 2 to 4
Education				\$500	\$50
Insurance				\$650	\$650
Irrigation Install				\$210	\$50
Electric Install				\$1,000	\$50
Hoophouse				\$10,000	\$0
Supplies (tools)				\$750	\$200
Site preparation				\$1,000	\$0
Permits				\$250	\$250
Construction labor				\$1,350	\$0
Payroll tax				\$181	\$0
<b>Total Fixed costs</b>				<b>\$15,891</b>	<b>\$1,250</b>

*Adapted from Conner, D., Model Business Plan for Season Extension with Hoophouses. Michigan State University*



# Sample Enterprise Budget: High Tunnel Production

## Variable costs

Direct materials				Year 1	Years 2 to 4
Seed				\$250	\$250
Fertilizer				\$40	\$40
Weed control				\$50	\$50
Insect control				\$40	\$40
Irrigation				\$10	\$10
Electricity				\$30	\$30
Harvest/packing supplies				\$585	\$310
		Subtotal		\$1,005	\$730
Labor					
Bed preparation				\$144	\$144
Transplanting, irrigation, and weed mang.				\$144	\$144
Pruning and trellising				\$144	\$144
Harvesting and packing				\$500	\$500
High tunnel clean up				\$100	\$100
Maintenance and management				\$460	\$460
		Subtotal		\$1,492	\$1,492
Total variable costs				\$2,497	\$2,222

*Adapted from Conner, D., Model Business Plan for Season Extension with Hoophouses. Michigan State University*

# Sample Enterprise Budget: High Tunnel Production

Expected crops, yields and revenue, year 1.

## Cool Season Crops

Crop	Planting area (sq. ft.)	Expected yield rate	Lb of produce	Average Price (\$/Lb)	Revenue if 70% sold
Salad mix	840	0.4	336	\$6	\$1,411
Spinach	840	0.8	672	\$4.50	\$2,117
Lettuce	210	1.2	252	\$1.00	\$176
Chard	210	3.2	672	\$1.50	\$706
SUM	2100				\$4,410

## Warm Season Crops

Crop	Planting area (sq. ft.)	Expected yield rate	Lb of produce	Average Price (\$/Lb)	Revenue if 70% sold
Tomato	1050	1.52	1596	\$2.50	\$2,793
Pepper	630	0.28	176.4	\$2.50	\$309
Eggplant	420	0.64	268.8	\$2.50	\$470
SUM	2100				\$3,572
Total year 1*					\$7,982

\*assuming 1 warm season and 1.5 cool season crops



# Net Return- High Tunnel Production

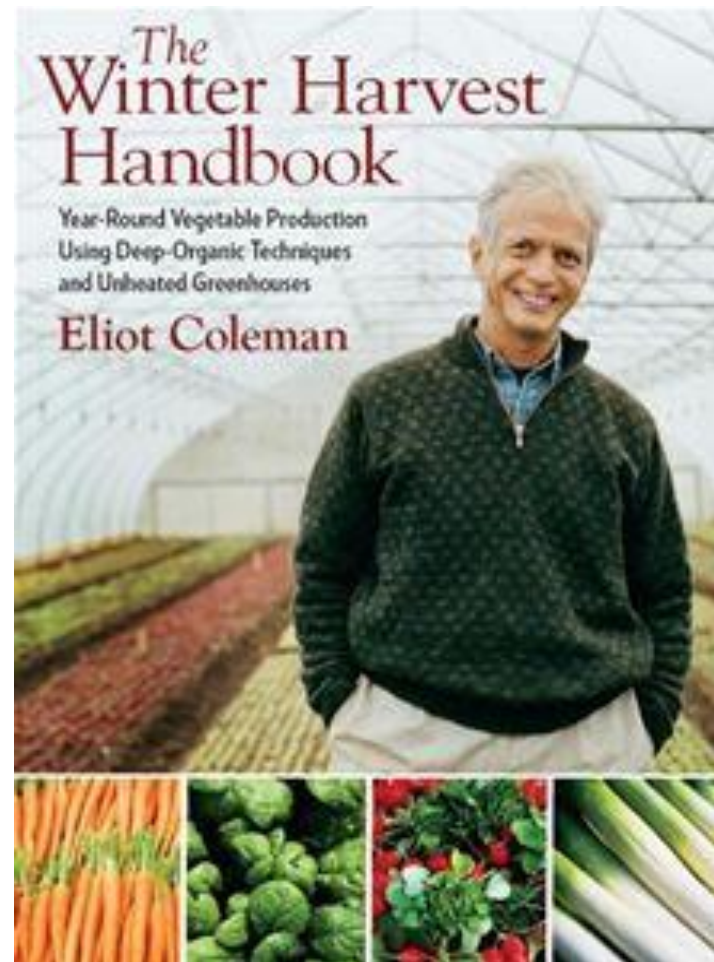
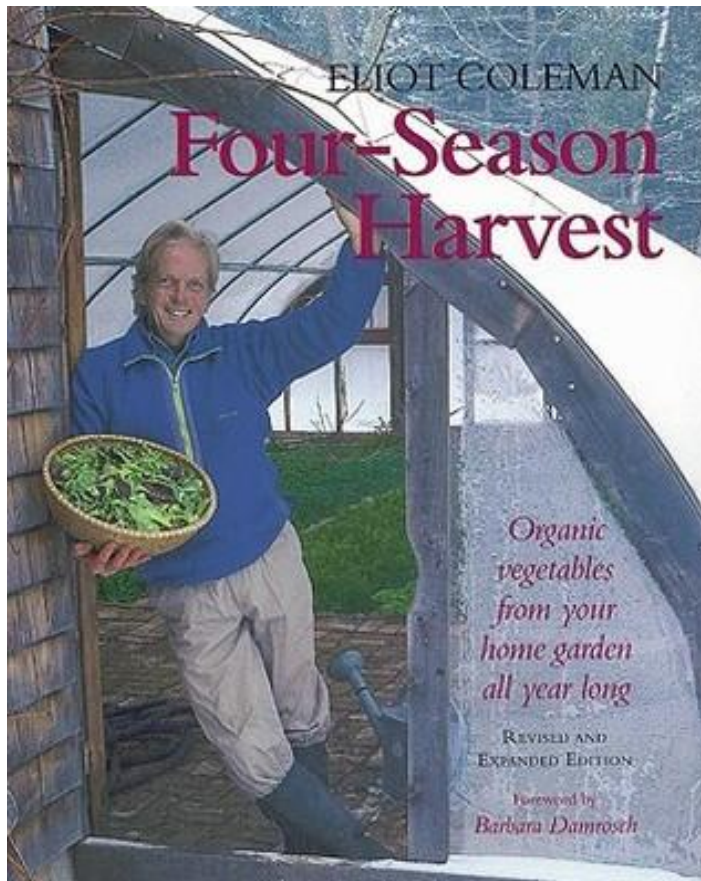
	Year 1	Year 2 to 4
Total Revenue	\$7,982	\$7,982
Total fixed and variable costs	\$18,388	\$3,472
Net Return	(\$10,406)	\$4,510

Payback: 3.3 years



Photo: Amanda Birk, PCO

ATTRA: Planning for Profit in Sustainable Farming



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# High Tunnel Web Site Resources

- [Hightunnels.org](http://Hightunnels.org) (extensive listing of online resources for high tunnel growing)
- Michigan State Hoop House/High Tunnels Website & Blog  
[hoophouse.msu.edu](http://hoophouse.msu.edu)
- Cornell University High Tunnels Website  
[www.hort.cornell.edu/hightunnel/](http://www.hort.cornell.edu/hightunnel/)
- High Tunnel Section of New England Vegetable Management Guide  
[nevegetable.org/cultural-practices/high-tunnels-0](http://nevegetable.org/cultural-practices/high-tunnels-0)
- New England Greenhouse Update  
[negreenhouseupdate.info](http://negreenhouseupdate.info)

# Additional Resources

- “Season Extension Techniques for Market Gardeners”. ATTRA Publication: [www.attra.ncat.org](http://www.attra.ncat.org)
- “High Tunnels” by Ted Blomgren and Tracy Frisch. Regional Farm and Food Project and Cornell University: <http://www.uvm.edu/sustainableagriculture/Documents/HighTunnels.pdf>
- “Growing for Market”: <http://www.growingformarket.com/>



# NRCS High Tunnel Program

- Environmental Quality Incentives Program (EQIP) and Transition to Organics Program
- Financial assistance up to 2,178 sq. ft.
- Contact NRCS



*Photo courtesy of ledgewoodfarm.com*

[www.nrcs.usda.gov](http://www.nrcs.usda.gov)

# Thank You

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*Helping people by championing small-scale, local, and sustainable solutions to reduce poverty, promote healthy communities, and protect natural resources.*